ATTACHMENT 11-1

MEMORANDUM

TO: Ethyl Corporation HiTEC 3000 Team

FROM: Alison Pollack

DATE: 12 April 1990

SUBJECT: HiTEC 3000 Analyses related to Clean Air Act

We have completed the analyses for supporting Appendix 11 on Clean Air Act issues. This memo describes the results; the memo of 3 April 1990 (attached) describes details of the analyses performed. All relevant tables are enclosed.

Three of the EPA regression-based tests were carried out for each of the four pollutants (HC, NMHC, CO, and NO_x) of interest. These are the only EPA tests that consider specific standards -- the violation mileage test, the maximum percentage of vehicles failing the standard test, and the "pivotal" cause or contribute test. Each of these tests was performed in three different ways -- 50,000 mile analysis based on linear regression, 50,000 mile analysis based on quadratic regression, and 75,000 mile analysis based on quadratic regression.

No overall adverse effects are seen for any pollutant in any of the violation mileage or maximum percentage of vehicles failing standard tests. Overall, the group of five cars pass all cause or contribute tests.

In addition to the EPA tests, we also carried out a mean effects analysis; the tabular results are enclosed. Note that the average emissions reported are weighted averages across the five models. These weighted averages show that this group of models passes the 50K hydrocarbon standard of 0.31 g/mi and the 50K non-methane HC standard of 0.25 g/mi, no matter which fuel is used. Neither the clear- nor the HiTEC 3000-fueled cars, on average, pass the 50K carbon monoxide standard of 3.4 g/mi. The good news is that the clear-fueled cars, on average, do not pass the 50K NO_x standard of 0.4 g/mi, while the HiTEC 3000-fueled cars do.

The tables also show the 75,000 mile averages, which can be compared to the proposed 100K standards. The results are similar to the 50K results: both clear- and HiTEC-fueled cars are below the HC and NMHC standards and above the CO standards, and the clear-fueled cars are above the NO_x standard while the HiTEC-fueled cars are below.

akp9763

MEMORANDUM

TO: Ethyl Corporation HiTEC 3000 Team

FROM: Alison Pollack

DATE: 3 April 1990

SUBJECT: HiTEC 3000 Analyses related to Clean Air Act

This memo describes proposed statistical analyses to be incorporated into Ethyl's HiTEC 3000 waiver application Appendix on Clean Air Act issues.

Revised Standards

We will perform a subset of the nine EPA statistical tests using the five vehicular models that, on average, pass the current 50K 0.41g/mi hydrocarbon standard -- Models C, E, G, H, and I. The standards to be addressed, as listed in Jeff Smith's 7 March 1990 memo, are:

	50,000 Miles	75,000 Miles
Total hydrocarbon (THC)	0.31	0.39
Non-methane hydrocarbon (NMHC)	0.25	0.31
Carbon monoxide	3.4	4.2
Oxides of nitrogen	0.4	0.5

Proposed Statistical Tests

Only three of the nine EPA statistical tests address violations of the standard. These are the violation mileage test, the maximum percent of vehicles failing the standard test, and the cause or contribute test, all of which are based upon regression fits to the data. We propose to perform each of these three tests for each of the three pollutants. For the 50,000 standards, we will perform the tests using both linear and quadratic regression fits; for the 75,000 mile standards we will base the tests upon quadratic regression alone.

akp9764

Methane Proportions

Most cars were rated for methane at 50,000 miles; typically duplicate ratings were performed. Model G, however, had no methane ratings at 50,000 miles and Model C methane ratings at 50,000 miles were not performed in duplicate. Because the only methane ratings we have are at 50,000 miles (except for one car for each model group and fuel combination at 75,000 miles) we must assume that the methane fraction does not vary by mileage. To estimate NMHC emission rates, then, two approaches are obvious. The first is to use the car-specific methane proportions, and the second is to use an average methane proportion across the three cars for each fuel within each model group. Since the first approach requires more programming and hence more time, and because it seems reasonable to assume one methane proportion for each fuel/model group combination, we recommend the second approach.

Don Hollrah has already compiled tables of the methane ratings, which he faxed to me yesterday afternoon, for Models C, E, G, and H. For each test, Don calculated the methane percent, then averaged these percents across all three cars for each fuel for each model group. I recommend a slight variation on Don's calculations. Rather than estimate the average methane percent as the average of each of the methane/total hydrocarbon ratios, I suggest the ratio of the average methane rating to the average total hydrocarbon rating. The ratio of the averages is a more precise estimate than the average of the ratios. The results are shown in the table below. The last line in the table, the average across the four model groups, is also calculated as the ratio of the averages rather than the average of the ratios. We suggest using these averages (one per fuel) to represent the methane proportions for Model G.

	EEE			HiTEC 3000		
Model	NMHC	THC	% Methane	NMHC	THC	% Methane
C	.155	.181	14.0	.177	.202	12.5
E	.187	.218	14.1	.181	.210	13.8
H	.421	.482	12.6	.466	.535	13.0
I	.178	.209	14.9	.215	.249	13.5
Average	.235	.273	13.6	.260	.299	13.2

akp9764

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Mean Effects of HiTEC 3000
Based on the five models that, on average, pass the current 50K .41 g/mi hydrocarbon standard

Data Set: ETHYL4S2
Pollutant: Hydrocarbons

OBSERVED INTEGRATED EMISSIONS PER MILE

Beginning Mileage	Ending Mileage	Scaling	Mean Integrated Emissions (a) HiTEC 3000 (g/mi)	Mean Integrated Emissions (a) EEE (g/mi)	HiTEC 3000 Effect (b) (g/mi)
1,000	50,000	Unscaled	0.217	0.204	0.013
1,000	50,000	Scaled (c)	0.223	0.204	0.019
50,000	75,000	Unscaled	0.284	0.264	0.020
50,000	75,000	Scaled (c)	0.290	0.264	0.026
1,000	75,000	Unscaled	0.239	0.224	0.015
1,000	75,000	Scaled (c)	0.245	0.224	0.021

OBSERVED MEAN EMISSIONS

Mileage	Scaling	Weighted Average Emissions (d) HiTEC 3000 (g/mi)	Weighted Average Emissions (d) EEE (g/mi)	HiTEC 3000 Effect (b) (g/mi)
25,000	Unscaled	0.215	0.217	-0.003
25,000	Scaled (c)	0.221	0.217	0.003
50,000	Unscaled	0.242	0.239	0.004
50,000	Scaled (c)	0.248	0.239	0.009
75,000	Unscaled	0.288	0.265	0.023
75,000	Scaled (c)	0.294	0.265	0.029
1,000	Unscaled	0.144	0.149	-0.006

Notes

(a) For each car, the emissions are integrated from the beginning mileage to the ending mileage and expressed as a rate in g/mi. Each figure is the mean of the car rates, weighting models by 1988 sales.
(b) These numbers give the average difference in emissions (HiTEC 3000 minus EEE).
(c) The HiTEC 3000 emissions are rescaled by subtraction of the initial difference between HiTEC 3000 and EEE, given in the final row of the table.
(d) Each figure is the mean of the car-means at the given mileage.

jpc9947

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Mean Effects of HiTEC 3000
Based on the five models that, on average, pass the current 50K .41 g/mi hydrocarbon standard

Data Set: ETHYL4S2
Pollutant: Carbon Monoxide

OBSERVED INTEGRATED EMISSIONS PER MILE

Beginning Mileage	Ending Mileage	Scaling	Mean Integrated Emissions (a) HiTEC 3000 (g/mi)	Mean Integrated Emissions (a) EEE (g/mi)	HiTEC 3000 Effect (b) (g/mi)
1,000	50,000	Unscaled	2.89	2.91	-0.02
1,000	50,000	Scaled (c)	2.89	2.91	-0.02
50,000	75,000	Unscaled	3.72	3.93	-0.21
50,000	75,000	Scaled (c)	3.71	3.93	-0.21
1,000	75,000	Unscaled	3.17	3.25	-0.08
1,000	75,000	Scaled (c)	3.17	3.25	-0.09

OBSERVED MEAN EMISSIONS

Mileage	Scaling	Weighted Average Emissions (d) HiTEC 3000 (g/mi)	Weighted Average Emissions (d) EEE (g/mi)	HiTEC 3000 Effect (b) (g/mi)
25,000	Unscaled	3.01	3.17	-0.16
25,000	Scaled (c)	3.01	3.17	-0.16
50,000	Unscaled	3.45	3.77	-0.31
50,000	Scaled (c)	3.45	3.77	-0.31
75,000	Unscaled	3.66	3.75	-0.09
75,000	Scaled (c)	3.66	3.75	-0.09
1,000	Unscaled	1.48	1.48	0.00

Notes

(a) For each car, the emissions are integrated from the beginning mileage to the ending mileage and expressed as a rate in g/mi. Each figure is the mean of the car rates, weighting models by 1988 sales.
(b) These numbers give the average difference in emissions (HiTEC 3000 minus EEE).
(c) The HiTEC 3000 emissions are rescaled by subtraction of the initial difference between HiTEC 3000 and EEE, given in the final row of the table.
(d) Each figure is the mean of the car-means at the given mileage.

jpc9947

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Mean Effects of HiTEC 3000
Based on the five models that, on average, pass the current 50K .41g/mi hydrocarbon standard

Data Set: ETHYL4S2
Pollutant: Nitrogen Oxides

OBSERVED INTEGRATED EMISSIONS PER MILE

Beginning Mileage	Ending Mileage	Scaling	Mean Integrated Emissions (a) HiTEC 3000 (g/mi)	Mean Integrated Emissions (a) EEE (g/mi)	HiTEC 3000 Effect (b) (g/mi)
1,000	50,000	Unscaled	0.37	0.38	-0.01
1,000	50,000	Scaled (c)	0.34	0.38	-0.04
50,000	75,000	Unscaled	0.36	0.49	-0.13
50,000	75,000	Scaled (c)	0.33	0.49	-0.16
1,000	75,000	Unscaled	0.37	0.42	-0.05
1,000	75,000	Scaled (c)	0.34	0.42	-0.08

OBSERVED MEAN EMISSIONS

Mileage	Scaling	Weighted Average Emissions (d) HiTEC 3000 (g/mi)	Weighted Average Emissions (d) EEE (g/mi)	HiTEC 3000 Effect (b) (g/mi)
25,000	Unscaled	0.45	0.44	0.01
25,000	Scaled (c)	0.42	0.44	-0.02
50,000	Unscaled	0.36	0.44	-0.08
50,000	Scaled (c)	0.33	0.44	-0.11
75,000	Unscaled	0.38	0.52	-0.14
75,000	Scaled (c)	0.35	0.52	-0.17
1,000	Unscaled	0.26	0.23	0.03

Notes

(a) For each car, the emissions are integrated from the beginning mileage to the ending mileage and expressed as a rate in g/mi. Each figure is the mean of the car rates, weighting models by 1988 sales.
(b) These numbers give the average difference in emissions (HiTEC 3000 minus EEE).
(c) The HiTEC 3000 emissions are rescaled by subtraction of the initial difference between HiTEC 3000 and EEE, given in the final row of the table.
(d) Each figure is the mean of the car-means at the given mileage.

jpc9947

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Mean Effects of HiTEC 3000
Based on the five models that, on average, pass the current 50K .41 g/mi hydrocarbon standard

Data Set: ETHYL4S2
Pollutant: Non-Methane Hydrocarbons

OBSERVED INTEGRATED EMISSIONS PER MILE

Beginning Mileage	Ending Mileage	Scaling	Mean Integrated Emissions (a) HiTEC 3000 (g/mi)	Mean Integrated Emissions (a) EEE (g/mi)	HiTEC 3000 Effect (b) (g/mi)
1,000	50,000	Unscaled	0.188	0.176	0.012
1,000	50,000	Scaled (c)	0.193	0.176	0.017
50,000	75,000	Unscaled	0.246	0.229	0.018
50,000	75,000	Scaled (c)	0.251	0.229	0.022
1,000	75,000	Unscaled	0.208	0.194	0.014
1,000	75,000	Scaled (c)	0.212	0.194	0.018

OBSERVED MEAN EMISSIONS

Mileage	Scaling	Weighted Average Emissions (d) HiTEC 3000 (g/mi)	Weighted Average Emissions (d) EEE (g/mi)	HiTEC 3000 Effect (b) (g/mi)
25,000	Unscaled	0.187	0.188	-0.001
25,000	Scaled (c)	0.191	0.188	0.003
50,000	Unscaled	0.211	0.207	0.004
50,000	Scaled (c)	0.215	0.207	0.008
75,000	Unscaled	0.250	0.229	0.020
75,000	Scaled (c)	0.254	0.229	0.025
1,000	Unscaled	0.125	0.129	-0.004

Notes

(a) For each car, the emissions are integrated from the beginning mileage to the ending mileage and expressed as a rate in g/mi. Each figure is the mean of the car rates, weighting models by 1988 sales.
(b) These numbers give the average difference in emissions (HiTEC 3000 minus EEE).
(c) The HiTEC 3000 emissions are rescaled by subtraction of the initial difference between HiTEC 3000 and EEE, given in the final row of the table.
(d) Each figure is the mean of the car-means at the given mileage.

jpc9947

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	38,377	37,960	+
I	99,000	99,000	0

EPA Sign Test: Observation of 1 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 50.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the linear regression line) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression line lies entirely below the standard between 0 and 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	30,746	31,158	-
I	99,000	99,000	0

EPA Sign Test: Observation of 0 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 100.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the linear regression line) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression line lies entirely below the standard between 0 and 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	36,928	39,621	-
C	36,248	99,000	-
G	40,425	45,181	-
H	31,353	0	+
I	25,599	45,553	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the linear regression line) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression line lies entirely below the standard between 0 and 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	13,911	2,397	+
C	99,000	49,381	+
G	99,000	99,000	0
H	28,463	33,236	-
I	99,000	99,000	0

EPA Sign Test: Observation of 2 '+' sign(s) in 3 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 50.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the linear regression line) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression line lies entirely below the standard between 0 and 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	37,308	37,350	-
I	99,000	99,000	0

EPA Sign Test: Observation of 0 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 100.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	27,673	29,426	-
I	99,000	99,000	0

EPA Sign Test: Observation of 0 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 100.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	35,569	38,673	-
C	35,290	99,000	-
G	21,573	25,749	-
H	27,122	0	+
I	17,712	24,767	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	14,470	5,831	+
C	99,000	99,000	0
G	99,000	99,000	0
H	24,351	30,815	-
I	99,000	99,000	0

EPA Sign Test: Observation of 1 '+' sign(s) in 2 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 75.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	62,714	54,345	+
I	99,000	99,000	0

EPA Sign Test: Observation of 1 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 50.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 75,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	48,757	45,254	+
I	99,000	99,000	0

EPA Sign Test: Observation of 1 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 50.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 75,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	67,904	99,000	-
C	50,126	99,000	-
G	99,000	99,000	0
H	99,000	99,000	0
I	55,783	99,000	-

EPA Sign Test: Observation of 0 '+' sign(s) in 3 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 100.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 75,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	Violation Mileage(a) (miles) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	21,623	14,665	+
C	99,000	99,000	0
G	99,000	99,000	0
H	39,022	48,258	-
I	99,000	99,000	0

EPA Sign Test: Observation of 1 '+' sign(s) in 2 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 75.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 75,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	0.13 (50,000)	0.15 (50,000)	+
C	0.01 (50,000)	2.87 (50,000)	+
G	0.00 (50,000)	0.00 (50,000)	0
H	83.91 (50,000)	86.17 (50,000)	+
I	0.00 (50,000)	0.00 (50,000)	0

EPA Sign Test: Observation of 3 '+' sign(s) in 3 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 12.50 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

a. For each mileage the percentage of vehicles failing the standard is estimated using the linear regression line. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs and is 0 if the slope is negative and 50,000 if the slope is positive.

b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	0.84 (50,000)	0.99 (50,000)	+
C	0.11 (50,000)	13.44 (50,000)	+
G	0.00 (50,000)	0.00 (50,000)	0
H	95.01 (50,000)	95.55 (50,000)	+
I	0.00 (50,000)	0.06 (50,000)	+

EPA Sign Test: Observation of 4 '+' sign(s) in 4 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 6.25 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

a. For each mileage the percentage of vehicles failing the standard is estimated using the linear regression line. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs and is 0 if the slope is negative and 50,000 if the slope is positive.

b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	82.06 (50,000)	76.85 (50,000)	-
C	83.42 (50,000)	14.19 (50,000)	-
G	66.48 (50,000)	57.16 (50,000)	-
H	60.44 (50,000)	73.26 (0)	+
I	77.46 (50,000)	53.57 (50,000)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. For each mileage the percentage of vehicles failing the standard is estimated using the linear regression line. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs and is 0 if the slope is negative and 50,000 if the slope is positive.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	100.00 (50,000)	100.00 (50,000)	0
C	31.69 (50,000)	51.38 (50,000)	+
G	0.09 (50,000)	0.07 (50,000)	-
H	99.58 (50,000)	97.80 (50,000)	-
I	4.02 (50,000)	1.84 (50,000)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 4 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 93.75 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. For each mileage the percentage of vehicles failing the standard is estimated using the linear regression line. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs and is 0 if the slope is negative and 50,000 if the slope is positive.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	0.10 (50,000)	0.02 (35,088)	-
C	0.00 (36,380)	0.31 (35,370)	+
G	0.00 (32,918)	0.00 (33,607)	0
H	70.19 (50,000)	78.79 (50,000)	+
I	0.00 (31,929)	0.00 (34,874)	0

EPA Sign Test: Observation of 2 '+' sign(s) in 3 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 50.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	0.75 (50,000)	0.21 (35,088)	-
C	0.01 (36,380)	3.27 (35,370)	+
G	0.00 (32,918)	0.00 (33,607)	0
H	88.48 (50,000)	92.31 (50,000)	+
I	0.00 (31,929)	0.03 (34,874)	+

EPA Sign Test: Observation of 3 '+' sign(s) in 4 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 31.25 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	73.43 (50,000)	55.44 (47,899)	-
C	77.86 (50,000)	8.98 (38,471)	-
G	69.67 (30,815)	55.36 (30,971)	-
H	56.33 (50,000)	70.29 (17,570)	+
I	69.36 (36,054)	52.71 (30,727)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	100.00 (50,000)	99.96 (46,160)	-
C	15.16 (37,440)	28.41 (41,307)	+
G	0.00 (39,985)	0.00 (33,786)	0
H	97.22 (50,000)	93.73 (50,000)	-
I	1.10 (42,930)	0.61 (35,336)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 4 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 93.75 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	0.19 (75,000)	0.04 (75,000)	-
C	0.00 (60,309)	0.00 (49,479)	0
G	0.00 (75,000)	0.00 (57,308)	0
H	68.45 (75,000)	91.52 (75,000)	+
I	0.00 (75,000)	0.00 (75,000)	0

EPA Sign Test: Observation of 1 '+' sign(s) in 2 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 75.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 75,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	1.26 (75,000)	0.36 (75,000)	-
C	0.00 (60,309)	0.00 (49,479)	0
G	0.00 (75,000)	0.00 (57,308)	0
H	87.84 (75,000)	97.84 (75,000)	+
I	0.00 (75,000)	0.00 (75,000)	0

EPA Sign Test: Observation of 1 '+' sign(s) in 2 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 75.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 75,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	56.75 (75,000)	21.60 (64,365)	-
C	91.25 (75,000)	11.66 (75,000)	-
G	17.73 (61,634)	8.15 (54,158)	-
H	24.76 (66,770)	34.21 (2,599)	+
I	79.92 (75,000)	12.65 (53,361)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 75,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	Maximum Estimated Percentage Failures (mileage)(a) EEE	HT3	Sign ('+'= adverse HT3 effect)
E	99.91 (75,000)	98.48 (61,672)	-
C	0.74 (49,354)	2.28 (49,603)	+
G	0.00 (56,940)	0.00 (65,372)	0
H	78.15 (59,770)	67.22 (65,448)	-
I	0.04 (75,000)	0.00 (55,896)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 4 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 93.75 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 75,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	32,000	29.34	29.51	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the linear regression line exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	.	.	.	-
C	47,000	0.08	10.08	+
G	.	.	.	-
H	39,000	75.98	76.04	+
I	.	.	.	-

EPA Sign Test: Observation of 2 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 81.25 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the linear regression line exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	.	.	.	-
C	.	.	.	-
G	11,000	9.55	10.05	+
H	0	32.81	73.26	+
I	.	.	.	-

EPA Sign Test: Observation of 2 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 81.25 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the linear regression line exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	0	5.56	42.09	+
C	27,000	5.37	10.54	+
G	.	.	.	-
H	.	.	.	-
I	.	.	.	-

EPA Sign Test: Observation of 2 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 81.25 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:
a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the linear regression line exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	38,000	51.56	51.88	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:
a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	40,000	79.20	79.28	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:
a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	0	28.74	59.11	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:
a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	0	7.54	14.70	+
C	22,000	6.07	10.19	+
G	.	.	.	-
H	.	.	.	-
I	.	.	.	-

EPA Sign Test: Observation of 2 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 81.25 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:
a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	37,000	8.50	10.24	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:
a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 75,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	31,000	13.92	14.05	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:

a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 75,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	0	5.81	34.12	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:
a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 75,000 miles.
b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures EEE	Percent Failures HT3	Sign ('+'= adverse HT3 effect)
E	3,000	2.05	11.36	+
C	.	.	.	-
G	.	.	.	-
H	.	.	.	-
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:

a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 75,000 miles.

b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

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